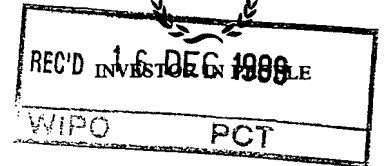




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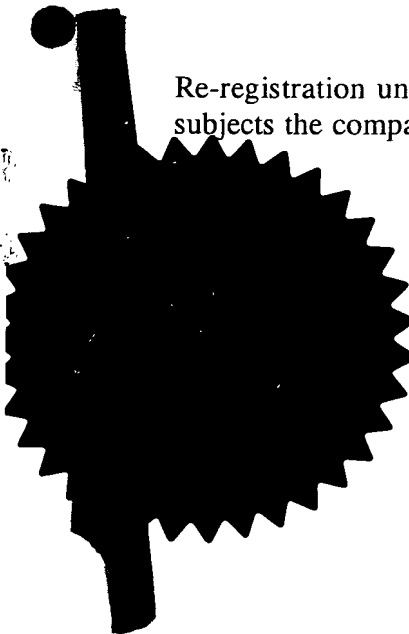
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*P. Mahoney*

Signed

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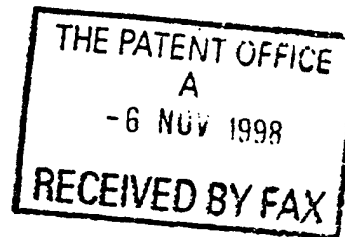
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1.	Your reference	SR1717		
2.	Patent application number (The Patent Office will fill in this part)	9		
3.	Full name, address and postcode of the or of each applicant ( <u>underline all surnames</u> )	STRUCTURAL POLYMER SYSTEMS LIMITED Love Lane Cowes Isle of Wight PO31 7EU  Patents ADP number (if you know it)  If the applicant is a corporate body, give the country/state of its incorporation England 007442494001		
4.	Title of the invention	COMPOSITE MOULDING MATERIALS		
5.	Name of your agent (if you have one)  "Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	Barker Brettell Medina Chambers Town Quay Southampton SO14 2AQ		
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	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of Filing (day/month/year)
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7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day/month/year)	
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES		

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Signature

Date

*Barker Brettell*

06/11/98

Barker Brettell

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G M Lomas

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## COMPOSITE MOULDING MATERIALS

This invention relates to composite moulding material, in particular to composite moulding material containing fibres for reinforcing a moulded product produced from the material.

- 5 When a number of sheets of such composite moulding material are superimposed in producing a finished moulded product of required thickness, problems can arise from air entrapment either within a sheet of a composite moulding material (intra-laminar) or between adjacent sheets (inter-laminar) since this leads to significant voids in the cured product.
- 10 Standard techniques that are used to reduce these problems are labour intensive (frequent vacuum debulking). These problems are exacerbated when very heavyweight materials (eg 1200 g/sq m glass unidirectional tape) are used in the composite moulding material, since they are quite impervious to air movement through their thickness. Such fibre
- 15 structures are however attractive as they offer cost and labour savings when compared to using lightweight fibre materials.

One technique that can significantly reduce the extent of intra- and inter-laminar voids is the use of dry reinforcement layers which are interleaved between sheets of composite moulding material as the product is built up.

- 20 One problem associated with this technique however is that the dry reinforcement layers will reduce the resin content of the final product. It is possible to increase the amount of resin in the composite moulding material to compensate for the loss of resin into the dry reinforcement layers. However, composite moulding material with a high resin content
- 25 can become difficult to handle due to excessive tack from the large amounts of resin on the surfaces thereof.

According to a first aspect of the invention there is provided a composite moulding material suitable for use in producing finished moulded products, comprising a resin composition layer and a fibrous layer, the fibrous layer being partially impregnated by the resin composition layer.

- 5 Preferably the fibrous layer comprises a substantially continuous unimpregnated portion.

- According to a second aspect of the invention there is provided a composite moulding material, suitable for use in producing finished moulded products, comprising a central resin composition layer which is  
10 located between two fibrous layers, the arrangement being such that at least one of the fibrous layers is partially impregnated by the central resin composition layer.

Preferably both the fibrous layers are partially impregnated by the resin composition layer.

- 15 According to a third aspect of the invention there is provided a composite moulding material, suitable for use in producing finished moulded products, comprising a resin composition layer and a fibrous layer, the arrangement being such that a surface of the fibrous layer is adhered to a facing surface of the resin composition layer.
- 20 Preferably there is substantially no impregnation of the fibrous layer by the resin composition layer.

- According to a fourth aspect of the invention there is provided a method of producing a finished moulded product comprising the use of a composite moulding material according to any preceding aspect of the  
25 invention.

Some embodiments of the invention will now be described, by way of example only.

One embodiment of a composite moulding material in accordance with the invention comprises a central resin composition layer located between  
5 two fibrous layers both of which are partially impregnated by the central resin composition layer. Such composite moulding material can be produced using standard hot melt prepregging equipment. Resin and catalyst are mixed and coated on to a sheet of siliconised paper film to a specific weight (normally between 20 - 200g/sq m). Reinforcement fibres  
10 are laid onto the resin composition layer to be subsequently compacted, and heated if necessary, to achieve the required degree of impregnation of the resin composition in the reinforcement fibres. When two such layers have been so produced the respective siliconised paper films are removed and the respective resinous surfaces are then brought together to form a  
15 single material. Thus each fibrous layer comprises a substantially continuous outermost layer which has not been impregnated by the central resin composition.

Manufacture of a finished moulded product using a plurality of stacked sheets of the exemplary embodiment of the inventive composite moulding  
20 material advantageously allows entrained air to pass through the unimpregnated outermost layer and out of the stack thus substantially alleviating the problem of void formation. The effective thickness of each unimpregnated outermost layer will, in part, determine the time taken for the outermost layers to become totally impregnated with resin  
25 composition. This is important since the outermost layers only remain breathable before full impregnation thereof.

Another advantage of the inventive composite moulding material is that of improved handling compared to conventional composite moulding materials, allowing the inventive material to more readily conform to complex shaped moulds. Moreover, higher weights of the inventive composite moulding material display improved handling since the outermost unimpregnated fibrous layers provide the material with a relatively higher drape.

When manufacturing a moulded product, sheets of the inventive composite moulding material can be used solely, or alternatively they can be used in conjunction with sheets of conventional composite moulding material using vacuum consolidation techniques. During such manufacture, however, it is important that there is contact between the unimpregnated outermost layers of the sheets of the inventive composite moulding material and the vacuum system so that entrained air can be fully evacuated. This can be achieved by simply ensuring that the sheets of the inventive material are cut to slightly larger dimensions and are linked by an air breathable medium (eg non-woven breather) to the vacuum system.

A number of resin systems are suitable for producing the inventive composite moulding material, for example, epoxy, polyester, bismaleimide, cyanate ester, phenolic and polyimide resins. Types of suitable fibres include glass, Aramid, carbon and polyethylene. The fibres can be in the form of tissue, chopped strand mat, continuous mat, woven fabrics, stitched fabrics or simple rovings. Unidirectional woven, stitched and non-woven mats have the desirable property that the fibres remain effective air breathing channels even at quite a late stage during the production of a moulded product. The orientation of the fibres in the fibrous layers can be  $0^\circ$ ,  $90^\circ$ ,  $0^\circ$ - $90^\circ$ ,  $\pm 45^\circ$  or quasi isotropic.

**EXAMPLE**

- Unidirectional E-glass woven reinforcement of 500g/sq m was combined to each side of a resin layer of 430g/sq m. This was interleaved with a conventional unidirectional composite moulding material of 1200g E-glass with a resin content of 30% by weight. In both types of composite moulding material the SP Systems SE 90 prepreg resin system was used. The laminate stack was then covered with nylon peel ply and a microperforated release film, a layer of 150g non-woven breather material and an impervious nylon vacuum bag.
- 5
- 10 A vacuum of 90% was applied and the assembly was heated from ambient to 70°C at 0.3°C/min held at 70° for 4 hours, and then ramped up to 120°C and held there for one hour. On cooling to ambient the moulded product was demoulded and examined. The dry reinforcement had completely wet out and the laminate was free of any entrained air.
- 15 Measurements of void content showed that this was less than 0.25%. The final fibre volume fraction achieved was 56%.





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